[Continued from the First Page.]

on our coast. It is also evident that the most desirable place for observation, especially for photography, will be Alaska, where the duration of the total phase is longest, and occurs when the sun is highest in the heavens, and most likely to be free from haze and cloud.

Professor Asaph Hall, of the National Observatory, with Professor Rogers, of the Hydrographic Office, and others started on the first of May for Alaska, probably Behring's Straits. Professor Hall took with him one of the large telescopes belonging to the University of Pennsylvania. He was in other respects completely equipped, and is expected to make a valuable series of observations.

Professor Davidson, of the United States Coast Survey, and party, in July arrived at Sitka, *en route* to Chilikahats county, Alaska, to observe the total eclipse. General Davis extended every possible aid to the expedition, and succeeded in bringing to Sitka the chief of Chilikahats, who promises to conduct and protect Professor Davidson and party.

The Iowa Expeditions.

Several expeditionary corps have selected Iowa as their ground of observation, and the town of Burlington especially will see brisk times this week.

In Philadelphia, a large party of fifteen photographers was organized by Professor Henry Morton, of the Franklin Institute, under the authority of Professor J. H. C. Coffin, of the Nautical Almanac Office, and with the aid of the governmental appropriation, started two days ago for Burlington.

The telescopes employed for this purpose are the High School Equatorial, of six inches aperture, and nine feet focal length; the Gettysburg Equatorial, from the Pennsylvania College of that place, also of six-inch aperture, and eight and a half feet focal length, and a smaller but very fine instrument of four inches aperture, from the University of Pennsylvania. These instruments were erected in a temporary building put up for the purpose in West Philadelphia, and during several weeks preceding active operations were in progress, by day and by night, in the adjustment of the instruments and the practicing of operators.

The organization of the party was in accordance with the suggestions of Mr. Warren De la Rue, who produced the pictures of the solar eclipse of 1860, said to be the best of the kind yet made. He recommended that on the occasion of future eclipses refractors of six-inch aperture and ten feet focal length should be used, mounted on equatorial stands with clock-work drivers. Each instrument to have a portable observatory with photographic appliances, including four plate-holders, and five baths, with *fused* nitrate of silver, which gives a more sensitive surface than the crystallized salt. Four operators should accompany each telescope, two being expert photographers, and all well practised with the instrument in making lunar photographs. It is estimated from pictures of former total eclipses that the light of the prominences have an actinic force of about 180 times that of the full moon, and about 900 times less powerful than that of the sun, therefore with a telescope of six-inch aperture a moderately quick, instantaneous exposure would secure pictures of the prominences, while perhaps from 15 to 20 seconds would be required for the corona.

This expedition comprises:—Professor Henry Morton, Professor A. M. Mayer, Professor C. F. Himes, Mr. O. H. Willard, Mr. J. Mahoney, Mr. H. C. Phillips, Mr. O. H. Kendall, Mr. J. C. Browne, Mr. W. J. Baker, Mr. J. Zentmayer, Mr. E. Moelling, Mr. E. L. Wilson, and others. Professor E. C. Pickering, of Boston, and Professor James McClune will also accompany the party, to make physical and astronomical observations.

The second party fitted out by the Naval Observatory consisted of Professors William Harkness and J. R. Eastman, United States Navy, in charge of the meteorological and astronomical work, and Dr. Edward Curtis, United States Army, under orders from the Surgeon-General's Department, to photograph, in connection with the observatory party, the various phases of the eclipse. This party is now at Des Moines, Iowa: they have mounted their instruments and made preliminary observations.

The "Litchfield Astronomical Expedition of Hamilton College," fitted out by the liberality of Mr. Edwin C. Litchfield, Clinton, N. Y., will also be stationed near Des Moines, Iowa, where the obscuration lasts nearly two minutes and forty-five seconds. While observations for precising the times of beginning and end will not be neglected (though nowadays of comparatively little use), the principal object will be the investigation of certain questions regarding the physical constitution of the sun and its envelopes. Two larger telescopes, respectively of nine and four inches aperture, will form the centre, around which will be arranged the other apparatus; several smaller telescopes and spy-glasses, three chronometers, a spectroscope, Nicols' prism, an extensive set of glasses of various colors and shades, another set of photographic paper, etc. Dr. C. H. T. Peters, of the Litchfield Observatory; Professor William A. Rogers, Frederick Hubbard, and J. H. Hall form the corps. One of the finest spectroscopes yet made was expressly imported for this expedition.

The accompanying parties are also preparing for observations in Iowa and Illinois:—

Professor J. H. C. Coffin and two assistants, Washington, to Burlington, Iowa.

Dr. B. A. Gould, Cambridge, Mass.; Professor C. A. Young and one assistant, Hanover, N. H.; Professor C. F. Brackett and one assistant, Brunswick, Me.; Miss Maria Mitchell, New York; Professor J. A. Langley, Pittsburg, Pa.; Professor J. M. Van Vleck, Middletown, Conn.; to Burlington or vicinity.

Professor S. Alexander, General Halstead and two assistants, Princeton, N. J., to Mount Pleasant, or Fairfield, or Boonesboro, Iowa.

Professor J. C. Watson and one assistant, Ann Arbor, Michigan, to Mattoon, Illinois.

Professor G. W. Hough, Albany, N. Y.

Dr. C. H. F. Peters, Clinton, N. Y.

Professor O. N. Roose, New York.

Professors Newcomb, Harkness, and Eastman, Observatory, Dr. Curtis, U. S. A., and three assistants, Washington, via Chicago to near Des Moines, on Chicago and Rock Island Railroad.

To make observations, each one independent of the other. Professor Yarnell will make observations at the Naval Observatory, Washington. The astronomical party from the Dearborn Observatory will join forces with the party from Washington Observatory, though they have not yet settled on their points of observation. Commander Ashe, of the Royal Navy, of the Quebec Observatory, and the Rev. Mr. Douglass, are at Jefferson City, Iowa, to view the eclipse.

The Springfield Corps.

Professor Austin, of the Smithsonian Institute, with a corps of skilful assistants, located themselves, several weeks since, at Springfield, Illinois, which, like the other stations selected, is directly on the line of totality. After several weeks' nightly observation, the Professor established a new and exact meridian line, to be called after that city, one hundred and fifty feet due west of the new State House dome. A square shaft of marble, sunk seven feet in the ground, marks the spot. The tents for observation are there erected, and all the necessary apparatus is at hand.

The Kentucky Corps.

Professor Joseph Winlock, of Kentucky, has charge of the observations to be made in that State by the Observatory of the Harvard College and the United States Coast Survey. The two important points in Kentucky are Falmouth, in Pendleton county, and Oakland, south of Cave City, at the farm of J. B. Wilder, Esq., of this city. Mr. Wilder has kindly placed his house at the disposal of the astronomical corps assigned to Oakland. There are many intermediate points between Falmouth and Oakland at which important observations may be made, especially at telegraph stations where the Morse paper fillet is used, and at these points Mr. Boyle, of the Union Telegraph Lines, is directing his attention. The other telegraph lines in the State will be called upon, and will undoubtedly lend their aid in this important work. Professor Winlock has with him a very able astronomical corps, who will be distributed to the important points for observations. He has also an ample supply of instruments of unsurpassed excellence for perfecting the work assigned to him. Among these are spectroscopic apparatus with astronomical attachments, with which it is expected very valuable contributions to science will be made.

Meteorological Observations.

Commodore B. F. Sands, Superintendent United States Observatory, has issued a circular to meteorological observers along the line of totality, in which he says:—

As the United States Observatory is to have all its available force in the field, expecting to contribute its full share of labor on this occasion, it is desirable that during the eclipse of the sun meteorological observations should be made within the belt of totality, with a barometer, a dry-bulb thermometer, a wet-bulb thermometer, a solar thermometer, with blackened bulb, inclosed, if possible, in a glass cylinder from which air has been exhausted, and an actionometer.

The barometer should be suspended in the shade, and, if provided with a thermometer, the temperature should be determined at each reading. The dry and wet-bulb thermometers should be suspended in the shade in such a manner as to prevent, as far as possible, the abnormal influence of radiation from surrounding bodies, and at the same time secure a free circulation of the air.

The solar thermometer should be placed in slender wooden crutches, about six inches above the green grass of a field or lawn, and in a locality where the direct solar rays shall reach it from sunrise to sunset.

Observations with the actionometer should be made in the open air, and the bulb should, as far as practicable, be protected from the influence of air currents.

If possible, observations should be made at each hour of the day and night of the 6th, 7th, and 8th of August, beginning at midnight of the 5th.

If observations cannot be made during the night, great care should be taken to make them carefully at each hour of the day.

A careful statement of the character of the weather should be made at each observation.

On the 7th of August observations with the actionometer should begin at 10 A. M., and be made at intervals of thirty minutes until the first contact of the limbs of the sun and moon, when they should be continued at intervals of ten minutes until the last contact, or until sunset. One observation should be made, if practicable, during totality.

The barometer should be read at intervals of twenty minutes while any portion of the sun is eclipsed, and once during totality.

The thermometers should be observed at intervals of ten minutes during the eclipse, and once during totality.

The time of the beginning of the total obscuration should be carefully noted by the clock or watch by which the meteorological observations are timed.

All persons who may make such observations as described will confer a great favor if they will forward their observations, together with the errors of their instruments, if known, to the Superintendent of the United States Naval Observatory, Washington, D. C.

Scientific Problems.

The number and equipment of these scientific expeditionary corps testify more strongly than mere words could do to the intense interest felt among educated men to accumulate further data for solving the problems of the constitutions of the sun and moon, the composition of solar light, etc. The theories thus far broached are all under trial.

The explanation usually given of the white corona is that it betokens a transparent, non-luminous atmosphere, extending beyond the photosphere or luminous atmosphere, analogous to our own atmosphere. The white light of the corona is accounted for by the reflection of that of the photosphere, very much as our own evening and morning twilight is produced by the reflection of the solar rays in our atmosphere. The irregular red masses seen projected into the white corona may prove to be immense volumes of thin cloudy smoke, or solid vaporous particles precipitated from the hot gaseous atmosphere which forms the corona. But there are various objections to these views. Nothing is as yet definitely settled; further observations and discussions are needed to *throw light* on the sun's physical constitution. One observer with the spectroscope pronounces the red or rose-colored projections to be red-hot hydrogen. The question of another planet or planets within the orbit of Mercury, as suggested by Le Verrier, to account for certain extraordinary perturbations of this planet, remains also to be settled. The total eclipse of the sun affords a good opportunity to search for the new planet or planets.

Solar Photographs.

The method of taking photographs of the sun was illustrated during the late experiments of the Philadelphia corps before starting westward, and is worthy a description.

The telescope is directed towards the sun, and its clock work is set in motion so that it may follow that body in its apparent diurnal path. Any error in this motion is immediately detected by means of the "finder," or small telescope, mounted on the back of the large one, like a little dog riding on a horse, which is provided with a small screen, on which the sun's image is projected, and it is at once corrected by an assistant who has charge of this special work.

In a "dark room" at one side, plates are being prepared, and are inserted one after another in the camera which is attached to the telescope, and then the exposure is made by allowing a plate of brass, with an opening in it but one-fortieth of an inch wide, to be drawn by a stout spring across the tube.

Notwithstanding the exceeding shortness of the time during which this minute opening is flying across and allowing the light to pass to the plate, so sensitive is this last that it was found necessary in addition to shut off all but one-sixteenth of the lens with a diaphragm or cap. After this *truly* "instantaneous" exposure, the plate is removed to another dark room, where it is developed, and then appears as a negative likeness of the jolly sun, with every "spot" on his face faithfully if not flatteringly depicted.

Several good pictures of the moon have been taken with exposures of one minute; and since De la Rue's experience indicates that the luminous prominences seen during the total phase have an actinic force 180 times greater than the full moon, it seems that one-third of a second would prove a sufficient exposure for this part of the work.

HISTORICAL DATA.

In the Chinese annals is found the earliest record of an eclipse; it is thought to be the solar eclipse of October 13, 2127 B. C. Dates of eclipses preserved in ancient history are of great value in enabling astronomers to fix important historic epochs. Thus, more than one point of doubt in regard to the motions of the moon was partly settled by the eclipse of Larissea, which Xenophon mentioned in the Anabasis as follows:

"This city, Larissea, when besieged by the king of Persia, at the time when the Persians were wresting the kingdom from the Medes, he could not make himself master of it by any means, when it happened that the sun, obscured by a cloud, disappeared; and the darkness continued till, the inhabitants being seized with consternation, the town was taken."

Other eclipses of note in history were those predicted by Thales, 585 B. C.; that connected with the expedition of Agathocles against Carthage, B. C. 310; and an eclipse which helped to decide the battle of Stiklastad, in the Scandinavian annals, August 31, 1030. In modern times we have often heard of the panic terror of ignorant populations; and there are even stories that in the eclipse of 1807 persons here and there thought the Judgment Day was coming.

Important points in Egyptian chronology have been settled by references to the eclipses, which were recorded in imperishable hieroglyphs by that nation of acute observers.

Old-time Eclipses.

The early English chronicles contain numerous passages relating to eclipses. William of Malmesbury thus refers to that of August 2, 1133, which was considered a revelation of calamity to Henry I:—"The elements manifested their sorrow at this great man's last departure. For the sun on that day at the sixth hour shrouded his glorious face, as the poets say, in hideous darkness, agitating the hearts of men by an eclipse: and on the sixth day of the week, early in the morning, there was so great an earthquake that the ground appeared absolutely to sink down; an horrid noise being first heard beneath the surface." The same writer, speaking of the total eclipse of March 20, 1140, says:—"During this year, in Lent, on the 13th of the kalends of April, at the ninth hour of the fourth day of the week, there was an eclipse throughout England, as I have heard: with us, indeed, and with all our neighbors, the obscuration of the sun also was so remarkable, that persons sitting at table, as it then happened almost everywhere, for it was Lent, at first feared that chaos was come again. Afterwards learning the cause, they went out and beheld the stars around the sun. It was thought and said by many, not untruly, that the King (Stephen) would not continue a year in the government."

Columbus made use of an eclipse of the moon—which was probably his only means of determining his longitude, and so the distance of America from Europe—which took place March 1, 1504, to relieve his fleet, which was greatly distressed for want of provisions. As a punishment to the islanders of Jamaica, he threatened to deprive them of the light of the moon. At first they were indifferent to his threats; but when the eclipse actually commenced, the barbarians vied with each other in the production of the necessary supplies for the Spanish fleet.

The total eclipse which occurred in England on June 17, 1433, was long remembered under the name of the "Black Hour;" that of 1598 was equally imprinted on the memories of the peasantry, and called to mind as the "Black Saturday;" while the total eclipse of 1652 is recorded in Scotland by the name of "Mirk Monday." According to the testimony of Dr. Halley to the Royal Society on the eclipse of 1715, the titles were not misapplied. He says:—"I forbear to mention the chill and damp which attended the darkness of this eclipse, of which most spectators were sensible, and equally judges. Nor shall I trouble you with the concern that appeared in all sorts of animals, birds, beasts, and fishes, upon the extinction of the sun, since ourselves could not behold it without some sense of horror."

The Eclipse of 1806—A Graphic Description by James Fenimore Cooper.

The interesting phenomena of the eclipse of 1806 are thus described by J. Fenimore Cooper in an entertaining paper which will be first published in *Putnam's Magazine* for September:—

When I left the court-house, a sombre, yellowish, unnatural coloring was shed over the country. A great change had taken place. The trees on the distant heights had lost their verdure and their airy characters, they were taking the outlines of dark pictures graven upon an unfamiliar sky. The lake wore a lurid aspect, very unusual. All living creatures seemed thrown into a state of agitation. The birds were fluttering to and fro, in great excitement; they seemed to mistrust that this was not the gradual approach of evening, and were undecided in their movements. Even the dogs, honest creatures, became uneasy, and drew closer to their masters. The eager look of interest and curiosity, which earlier in the morning had appeared in almost every countenance, was now changed to an expression of wonder or anxiety or thoughtfulness, according to the individual character.

Every house now gave up its tenants. As the light failed more and more with every passing second, the children came flocking about their mothers in terror. The women themselves were looking about uneasily for their husbands. The American wife is more apt than any other to turn with affectionate confidence to the stronger arm for support. The men were very generally silent and grave. Many a laborer left his employment to be near his wife and children, as the dimness and darkness increased.

I once more took my position beside my father and my brothers, before the gates of our own grounds. The sun lay a little obliquely to the south and east, in the most favorable position possible for observation. I remember to have examined, in vain, the whole dusky canopy in search of a single cloud. It was one of those entirely unclouded days, less rare in America than in Europe. The steadily waning light, the gradual approach of darkness, became the more impressive as we observed this absolutely transparent state of the heavens. The birds, which a quarter of an hour earlier had been fluttering about in great agitation, seemed now convinced that night was at hand. Swallows were dimly seen dropping into chimneys, and martins returned to their little boxes, the pigeons flew home to their dove-cots, and through the open door of a small barn we saw the fowls going to roost.

The usual flood of sunlight had now become so much weakened that we could look upward long and steadily without the least pain. The sun appeared like a young moon of three or four days old, though, of course, with a larger and more brilliant crescent. Looking westward a moment, a spark appeared to glitter before my eye. For a second I believed it to be an optical delusion, but in another instant I saw it plainly to be a star. One after another they came into view, more rapidly than in the evening twilight, until perhaps fifty stars appeared to us in a broad, dark zone in the heavens, crowning the pines on the western mountain. This wonderful vision of the stars during the noontide hours of day filled the spirit with singular sensations.

Suddenly one of my brothers shouted aloud, "The moon!" Quicker than thought my eyes turned eastward again, and there floated the moon, distinctly apparent, to a degree that was almost fearful. The spherical form, the character, the dignity, the substance of the planet, were clearly revealed as I have never beheld them before or since. It looked grand, dark, majestic, and mighty, as it thus proved its power to rob us entirely of the sun's rays. We are all but larger children. In daily life we judge of objects by their outward aspect. We are accustomed to think of the sun, and also of the moon, as sources of light, as ethereal, almost spiritual, in their essence. But the positive material nature of the moon was now revealed to our senses, with a force of conviction, a clearness of perception, that changed all our usual ideas of connection with the planet. This was no interposition of vapor, no deceptive play of shadow; but a vast mass of obvious matter had interposed between the sun above us and the earth on which we stood. The passage of two ships at sea, sailing on opposite courses, is scarcely more obvious than this movement of one world before another. Darkness like that of an early night now fell upon the village.

My thoughts turned to the sea. A sailor at heart, already familiar with the face of the ocean, I seemed, in mental vision, to behold the grandeur of that vast pall of supernatural shadow falling suddenly upon the sea during the brightest hour of the day. The play of light and shade upon the billows, always full of interest, must at that hour have been indeed sublime. And my fancy was busy with pictures of white-sailed schooners, and brigs, and ships, gliding like winged spirits over the darkened waves.

I was recalled by a familiar and insignificant incident, the dull tramp of hoofs on the village bridge. A few cows, believing that night had overtaken them, were coming homeward from the wild open pastures about the village. And no wonder the kindly creatures were deceived; the darkness was now much deeper than the twilight which usually turns their faces homeward; the dew was falling imperceptibly, as much so as at any hour of the previous night, and the coolness was so great that the thermometer must have fallen many degrees from the great heat of the morning. The lake, the hills, and the buildings of the little town were swallowed up in the darkness. The absence of the usual lights in the dwellings rendered the obscurity still more impressive. All labor had ceased, and the hushed voices of the people only broke the absolute stillness by subdued whispering tones.

"Whisk! The whip-poor-will!" whispered a friend near me; and at the same moment, as we listened in profound silence, we distinctly heard from the eastern bank of the river the wild, plaintive note of that solitary bird of night, slowly repeated at intervals. The song of the summer birds, so full in tune, had entirely ceased, for the last half hour. A bat came flitting about our heads. Many stars were now visible, though not in sufficient number to lessen the darkness. At one point only, in the far distant northern horizon, something of the brightness of dawn appeared to linger.

At 11·12 the moon stood revealed in its greatest distinctness—a vast black orb, so nearly obscuring the sun that the face of the great luminary was entirely and absolutely darkened, though a corona of rays of light appeared beyond. The gloom of night was upon us. A breathless intensity of interest was felt by all. There would appear to be something instructive in the feeling with which man gazes at all phenomena in the heavens. The peaceful rainbow, the heavy clouds of a great storm, the vivid flash of electricity, the flitting meteor, the beautiful lights of the aurora borealis, fickle as the play of fancy—these never fail to fix the attention with something of a peculiar feeling, differing in character from that with which we observe any spectacle on the earth. Connected with all grand movements in the skies there seems an instinctive sense of inquiry, of anxious expectation, akin to awe, which may possibly be traced to the echoes of grand Christian prophecies, whispering to our spirits and endowing the physical sight with some mysterious mental prescience. In looking back to that impressive hour, such now seem to me the feelings of the youth making one of that family group, all apparently impressed with a sensation of the deepest awe. I speak with certainty. A clearer view than I had ever yet had of the majesty of the Almighty, accompanied with a humiliating, and, I trust, a profitable, sense of my own utter insignificance. That movement of the moon, that sublime voyage of the worlds, often recurs to my imagination, and even at this distant day as distinctly, as majestically, and nearly as fearfully, as it was then beheld.

A group of silent, dusky forms stood near me; one emotion appeared to govern all. My father stood immovable, some fifteen feet from me, but I could not discern his features. Three minutes of darkness, all but absolute, elapsed. They appeared strangely lengthened by the intensity of feeling and the flood of overpowering thought which filled the mind.

Thus far the sensation created by this majestic spectacle had been one of humiliation and awe. It seemed as if the great Father of the Universe had visibly and almost palpably veiled His face in wrath. But, appalling as the withdrawal of light had been, most glorious, most sublime, was its restoration! The corona of light above the moon became suddenly brighter, the heavens beyond were illuminated, the stars retired, and light began to play along the ridges of the distant mountains. And then a flood of grateful, cheerful, consoling brightness fell into the valley, with a sweetness and a power inconceivable to the mind unless the eye has actually beheld it. I can liken this sudden, joyous return of light, after the eclipse, to nothing of the kind that is familiarly known. It was certainly nearest to the change produced by the swift passage of the shadow of a very dark cloud, but it was the effect of this instantaneous transition, multiplied more than a thousand fold. It seemed to speak directly to our spirits, with assurance of protection, of gracious mercy, and of that Divine love which has produced all the glorious combinations of matter for our enjoyment. It was not in the least like the gradual dawning of day, or the actual rising of the sun. There was no gradation in the change. It was sudden, amazing, like what the imagination would teach us to expect of the advent of a heavenly vision. I know that philosophically I am wrong; but, to me, it seemed that the rays might actually be seen flowing through the darkness in torrents, till they had again illuminated the forest, the mountains, the valley, and the lake with their glowing, genial touch.

There was another grand movement, as the crescent of the sun reappeared, and the moon was actually seen steering her course through the void. Venus was still shining brilliantly.

The second passage of the moon lasted but a moment, to the naked eye. As it ceased, my eye fell again on the scene around me. The street, now as distinctly seen as ever, was filled with the population of the village. Along the line of road stretching for a mile from the valley, against the side of the mountain, were twenty wagons bearing travellers, or teams from among the hills. All had stopped on their course, impelled, apparently, by unconscious reverence as much as by curiosity, while every face was turned toward heaven, and every eye drank in the majesty of the sight. Women stood in the open street, near me, with streaming eyes and clasped hands, and sobs were audible in different directions. Even the educated and reflecting men at my side continued silent in thought. Several minutes passed before the profound impressions of the spectacle allowed of speech. At such a moment the spirit of man bows in humility before his Maker.

The changes of the unwonted light, through whose gradations the full brilliancy of the day was restored, must have been very similar to those by which it had been lost, but they were very little noted. I remember, however, marking the instant when I could first distinguish the blades of grass at my feet; and, later again, watching the shadows of the leaves on the ground walk. The white lilies in my mother's flower garden were observed by others among the first objects of the vegetation which could be distinguished from the windows of the house. Every living creature was soon rejoicing again in the blessed restoration of light after that frightful moment of a night at noonday.

Men who witness any extraordinary spectacle together are apt, in after times, to find a pleasure in conversing on its impressions. But I do not remember to have heard a single being freely communicative on the subject of his individual feelings at the most solemn moment of the eclipse. It would seem as if sensations were aroused too closely connected with the constitution of the spirit to be irreverently and familiarly discussed. I shall only say that I have passed a varied and eventful life, that it has been my fortune to see earth, heaven, ocean, and man in most of their aspects; but never have I beheld any spectacle which so plainly manifested the majesty of the Creator, or so forcibly taught the lesson of humanity to man, as a total eclipse of the sun."

Eclipse of 1842.

Arago thus describes the total eclipse of the sun in the south of France in 1842:—

At Perpignan only the sick remained in-doors. From early dawn the people covered the terraces, the city ramparts, all the knolls and vantage points from which they could hope to see the sun rise. At the citadel we had under our eyes, besides the numerous groups of citizens, the soldiers who were about to be reviewed. The time for the beginning of the eclipse approached. Nearly 20,000 persons, smoked glass in hand, were scanning the radiant orb, now projected upon an azure sky. Hardly had we, aided by powerful glasses, begun to distinguish the slight shade obscuring the western limb of the sun, when a shout, the mingled sound of 20,000 different voices, apprised us that our observation had preceded by some seconds only that made by 20,000 improvised astronomers with the naked eye, in this their first essay. A lively curiosity, the spirit of emulation, and a desire not to be forestalled, seemed to endow their natural vision with an unaccustomed penetration and power.

Between the commencement of the eclipse and the time which closely preceded the total disappearance of the sun, we remarked nothing worthy of record in the countenances of the numerous spectators. But when the sun, narrowed to a mere line, began to throw over the horizon but a faint light, an anxiety spread through the whole crowd; each man felt impelled to communicate his impressions to his neighbor. Then began a dull roar, like that of a distant sea after a tempest. The noise became louder in proportion to the thinning of the slender solar crescent. Finally the crescent vanished. Darkness succeeded suddenly to the light, and an absolute silence marked this phase of the eclipse, as sharply as did the pendulum of our astronomical clock.

The phenomenon, in its magnificence, had triumphed over the restlessness of youth, over the frivolity which certain men take for a sign of superiority, and over the noisy indifference of which the soldiers ordinarily make their boast. A profound calm reigned, too, in the air; even the birds ceased their song. After a solemn waiting of about two minutes' duration, transports of joy, frantic applause saluted, with the same accord, the same spontaneity, the reappearance of the first solar rays. To the melancholy self-collectedness produced by indefinable sentiments succeeded a lively satisfaction, the evidence of which no one dreamed of suppressing or of moderating. For the majority of the public the phenomenon had reached its limit. The other phases of the eclipse had few attentive observers, except those devoted to the study of astronomy.

Mr. Bailly thus writes of the same eclipse, showing how even astronomers may lose their presence of mind momentarily by the awful brilliancy of the spectacle:—

"I had noted down, on paper, the time of my chronometer, and was in the act of counting the seconds in order to ascertain the time of inner contact, when I was astounded by a tremendous burst of applause from the streets below, and the same moment was electrified at the sight of one of the most brilliant and splendid phenomena that can well be imagined. For, at that instant, the dark body of the moon was suddenly surrounded with a corona, or kind of bright glory, similar in shape and relative magnitude to that which painters draw round the heads of saints, and which by the French is designated an *aureole*. Pavia contains many thousand inhabitants, the majority part of whom were at this early hour walking about the streets and squares, or looking out of windows, in order to witness the long-talked-of phenomenon; and when the total obscuration took place, which was *instantaneous*, there was an universal snout from every observer, which 'made the welkin ring;' and for the moment withdrew my attention from the object with which I was immediately occupied." The observers of the eclipse of 1860 in Labrador saw "the dark shadow advance from the west with a frightful rapidity, and then pass over. It looked like a dark column or a very dark cloud. The tint of the sky during the totality was of an intense blue. The dark moon appeared to hang out in space between us and the sun. A gloomy unearthly light fell upon all objects, impressing one with the idea that some fearful calamity was about to happen. The wind, which had been blowing in gusts, now sank, and a death-like stillness prevailed. A little solitary bird poured forth a melancholy song, and then the stillness appeared even greater than before. Capella and other stars were seen."

Eclipse of 1851.

For the grand effects of a total eclipse on the surrounding scenery, the following description by Mr. Hind of that which he observed on the 28th of July, 1851, may be taken as a sample. He says:—

"The aspect of nature during the total eclipse was grand beyond description. A diminution of light over the earth was perceptible a quarter of an hour after the beginning of the eclipse, and about ten minutes before the extinction of the sun the gloom increased very perceptibly. The distant hills looked dull and misty and the sea assumed a dusky appearance, like that it presents during rain. The daylight that remained had a yellowish tinge, and the azure blue of the sky deepened to a purplish violet hue, particularly towards the north. But notwithstanding these gradual changes, the observer could hardly be prepared for the wonderful spectacle that presented itself when he withdrew his eye from the telescope, after the totality had come on, to gaze around him for a few seconds. The Southern heavens were then of a uniform purple grey color, the only indication of the sun's position being the luminous corona, the light of which contrasted strikingly with that of the surrounding sky. In the zenith and north of it the heavens were of a purplish-violet, and appeared very near, while in the northwest and northeast broad bands of yellowish crimson light, intensely bright, produced an effect which no person who witnessed it can ever forget. The crimson appeared to run over large portions of the sky in these directions irrespective of the clouds. At higher altitudes the predominant color was purple. All nature seemed to be overshadowed by an unnatural gloom; the distant hills were hardly visible; the sea turned lurid red; and persons standing near the observer had a pale, livid look, calculated to produce the most painful sensations. The darkness, if it can be so termed, had no resemblance to that of night. At various places within the shadow, the planets Venus, Mercury, and Mars, and the brighter stars of the first magnitude, were plainly seen during the total eclipse. Animals were frequently much affected. Cocks crowed at Helsingborg, though the sun was only hidden there thirty seconds, and the birds sought their resting-places as if night had come on."

Eclipse of 1861.

The Astronomer Royal, Dr. Airy, proceeded to Spain in 1860, with a large number of astronomers, provided with complete apparatus for astronomical observations and for photographing. It was of this eclipse that Mr. De la Rue made such excellent photographs. Mrs. Airy thus vividly describes the phenomena:—

"A gloominess gradually crept over the whole scene as if a storm were coming on. The southern mountains beyond the Ebro began to stand up strangely black. Then a sickly green hue overspread the whole nearer landscape. A peculiarly mournful sighing wind, cold and strong, began to rise, as if from among the large old trees beneath us on the north side of the hill. The butterflies disappeared, but the swifts continued on the wing. These appearances grew more and more intense, and all 'instructions' were totally forgotten in the excitement of the moment. It became very cold, and I was glad to wrap myself in a large Scotch plaid.'

Half a minute before totality Lieutenant Gillis speaks of seeing the purplish-black moon "for the first time in my life in its true form—a sphere and not a disk. At the moment of totality beads of golden and ruby-colored light flashed almost entirely round the moon." This flickering band broke up suddenly, and the rose-colored protuberances attracted Lieutenant Gillis' attention so strongly that he forgot the corona and lost the beat of the chronometer. Indeed, the most experienced observers are often thrown off their guard at the moment of inner contact.

In Spain, just before the totality, Mr. Airy saw through the telescope, "while the white sun was still shining, two red prominences of great splendor, and one double floating red cloud. The white corona formed round the moon all at once; and the moon was seen complete, with dazzling sun, brilliant corona, and brilliant prominences." To the naked eye, however, the crescent had diminished to a thread. "The gloom," continues Mr. Airy, "was everywhere intense. I was particularly struck with the moaning of the wind among the old forest-trees beneath me. The swifts had disappeared. A deeper gloom filled the sky in the northwest, and came rapidly on. The moment of totality had come; the whole air was at once filled with darkness, yet it was darkness through which mountain and valley could be distinctly seen. For a moment we seemed to be in the midst of a streaky shower of smoke or fine dust, which, however, was perfectly clear, and which could not be felt. The range of southern hills was of an inky black, while the sky beyond them was an intense golden orange. My shadow on the ground was quite black and sharp as in the clearest moonlight." "The corona was a bright radiating glory, its appearance made very singular from the projection of four or five brilliant beams at about equal intervals, far beyond the width of all the rest. I could not, with the unarmed eye, see the red prominences." At the reappearance of the sun "we saw the dark shadow distinctly sweeping away along the valley to the southeast, a path of darkness, and the clear daylight breaking out behind it."

The darkness of a total eclipse is doubtless similar both in tint and in degree to that of a very heavy thunder-storm. This peculiar tint of shade is thus caused:—The cone of the moon's shadow, though it envelopes the spectator, does not inclose the whole atmosphere above his horizon. The mass of unenveloped air catches the sunlight, and reflects it into the region of the total eclipse, making a peculiarly solemn twilight, which has no analogy in all the appearances of nature.

Mr. Warren De la Rue also gives the following description:—

"When the sun was reduced to a small crescent, the shadows of all objects were depicted with great sharpness and blackness, reminding one of the effects of illumination with electrical light. The sky at this period assumed an indigo tint, and the landscape a hue of bronze."

Total Eclipses of the Nineteenth Century.

Between 1800 and 1901, there are only four of these eclipses in any part of our Atlantic coast, the extent of which is nearly 2000 miles; and as the average width of the moon's shadow at the times of these eclipses is about 100 miles, it is evident that in only a fifth of this coast is there a total obscuration of the sun in the whole of the nineteenth century.

The *first*, and most remarkable of the four, took place here about half an hour before noon, on June 16, 1806, when the centre of the shadow, then one hundred and fifty miles wide, passed from Albany to Boston, and caused that striking phenomenon which is even now so well remembered, a "totality" of five minutes' duration. This eclipse will return for the fourth time on July 29, 1878, when, it is believed, the shadow will pass from British Columbia, over Colorado and Texas, to the Gulf of Mexico.

The *second* occurred on Nov. 30, 1834. It was total in part of Kansas, Arkansas, Alabama, Georgia and South Carolina; at Beaufort, in the last State, where it was central, the duration of totality, as observed by a correspondent, was 1 min. 49·6 sec., or only a little more than a third of that time, in June, 1806. The next return of this eclipse will take place next year on Dec. 22, 1870, when it will be total in the south of Europe, near Cadiz, Gibraltar, Constantinople, and in the island of Sicily.

The *third* of the four occurs on August 7th. This eclipse is the first return of that of July 28, 1851, which was so carefully observed in Sweden by many eminent English astronomers, and by the late Professor Bond, of the Observatory of Harvard University. All the savans saw, during the totality, the wonderful corona as usual, also red flames or prominences in different points around the moon. These flames have also been seen in other total eclipses, and during the eclipse so remarkable for the length of its totality (quite 6¾ minutes), which occurred in India last year, on August 18, they attracted the particular attention of all the numerous observers from England, France, and Germany who, with the great assistance of the new instrument, the spectroscope, seem to have come to the conclusion that these flames or prominences are incandescent or highly heated gas (hydrogen), extending 50,000 or 60,000, etc., miles all around the sun.

Since that eclipse, two of the astronomers who observed it in India (Mr. Lockyer and M. Janssen) have simultaneously ascertained that under favorable conditions these flames may be seen even when the sun is not eclipsed. It, therefore seems strange that they have not always been seen when the sun was totally eclipsed; but it is believed they were not noticed here during the great eclipse of June, 1806, and they certainly were not at Beaufort, S. C., in November, 1834, although the star "Antares" (then in conjunction with the sun, and, therefore, distant only by its latitude 4½ degrees) was seen nearly as soon as the corona.

The *fourth* will take place on May 28, 1900. It will be total in part of North Carolina and Virginia, but the width of the shadow will hardly exceed fifty miles; indeed, at the return of this eclipse, which occurred on April 28, 1846, it was annular where the sun was low and total only where it was high, viz., in the island of Cuba, etc.

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